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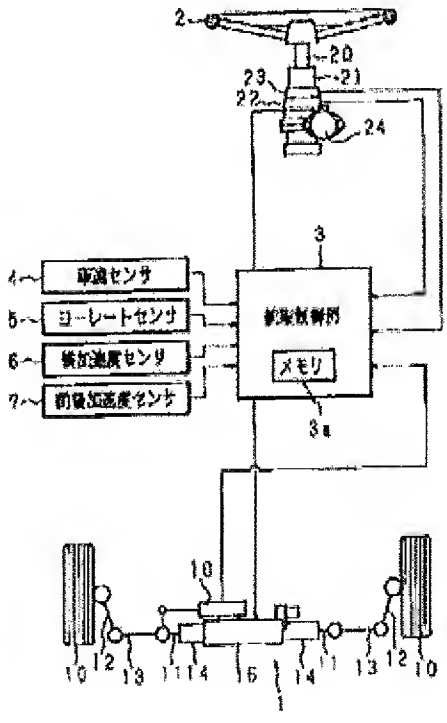
## (54) STEERING DEVICE FOR VEHICLE

(57)Abstract:

PROBLEM TO BE SOLVED: To eliminate strange feeling of a driver by comparing the steering direction of a steering means and the steering direction by an actuator, and suppressing a steering force of the actuator when the steering directions are different from each other so that further steering is done in the direction contrary to the steering direction.

SOLUTION: A steering device is provided with a steering mechanism 1 for having a pair of wheels 10 and 10 for steering arranged right and left of a car body do steering, a steering wheel 2 as a steering means not connected to the steering mechanism 1, and a steering control part 3 constituted by using a micro processor. By this, when the steering direction of the steering mechanism 1 is different from the steering direction of the steering wheel 2, an output to a steering motor 15 for driving the steering mechanism 1 is reduced so that a rotation position of the steering wheel 2 and a corresponding steering position of the steering mechanism 1 are not largely different from each other, and steering feeling can be remarkably improved.



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CLAIMS

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[Claim(s)]
[Claim 1]A steering engine style and a mechanically uncoupling steersman stage characterized by comprising the following, A steering angle detection means to detect a steering angle of this steersman stage, and a steering angle detection means to detect a steering angle of said steering engine style, Steering gear for vehicles provided with an actuator which applies steering power to said steering engine style according to a deviation of a detection value of a steering angle of said steering angle detection means, and a detection value of a steering angle of said steering angle detection means.
A comparison means to compare a steering direction of said steersman stage, and the steering direction by said actuator.
A control means which makes steering power of said actuator control when said steering direction differs from said steering direction.

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## DETAILED DESCRIPTION

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[Detailed Description of the Invention]
[0001]
[Field of the Invention]As for this invention, the steersman stage and a steering engine style are mechanically related with the uncoupling steering gear for vehicles.
[0002]
[Description of the Prior Art]The steersman stage and a steering engine style mechanically the uncoupling steering gear for vehicles, The steering motor which becomes a steering engine style from the electric motor as an actuator for a steering as well as the actuator for steering assistance in a power steering device is arranged, By driving said steering motor based on the detection value of the steering angle of a steersman stage slack steering wheel, it has the composition of making the guide according to steering of a steering wheel performing.
[0003]
[Problem(s) to be Solved by the Invention]However, in the conventional composition like the above, When run that cutback operation of steering wheels, such as a slalom run, is performed for a short time is performed, since the steering direction of a steering engine style turns into a different direction from the steering direction of a steering wheel by the response delay produced unescapable [ the steering engine style side ], a driver senses sense of incongruity.
[0004]Drawing 5 is a mimetic diagram showing the directional relation of a steering wheel and a steering engine style. In drawing 5, tn (n= 1, 2, --) shows the time of sampling the steering angle theta and the steering angle theta in a predetermined control cycle. In order to simplify explanation, the steering angle theta by the side of a steering engine style is set to 1:1 to the steering angle theta by the side of a steering wheel.
[0005]For example, it guides to the right 50 degrees (theta= 50 degrees) of the steering wheels are turned off on the right, and in agreement [ a steering engine style ] with this on the other hand at the t1 time, and is in a 40 degrees (theta= 40 degrees) position to the right at this time. Therefore, at this time, since the deviation of the steering angle theta and the steering angle theta is +10 degrees, a steering engine style guides to the right further so that it may become theta=theta.

[0006]And since the steering engine style follows to theta= 45 degrees in between at the t1 - t2 time at the t2 time when a driver steers 2 degrees of steering wheels to the left conversely (theta= 48 degrees), the deviation in this t2 time will be +3 degrees. For this reason, although a steering engine style performs 3-degree guide to the right further, in spite of turning off the steering wheel leftward, a steering engine style results in guiding to an opposite direction. Although this state is corrected at the next sampling time (at the t3 time), such a state may happen succeeding the case where a cutback is performed frequently.
[0007]This invention is made in view of this situation, and is a thing.
The purpose is to provide the steering gear for vehicles which can cancel a driver's sense of incongruity by controlling that a steering engine style guides to the steering direction and opposite direction of a steering wheel further, when the steering direction differs from the steering direction of a steering wheel.

[0008]
[Means for Solving the Problem]A steersman stage with mechanically uncoupling steering gear for vehicles which this invention requires for this invention as a steering engine style, A steering angle detection means to detect a steering angle of this steersman stage, and a steering angle detection means to detect a steering angle of said steering engine style, Steering gear for vehicles provided with an actuator which applies steering power to said steering engine style according to a deviation of a detection value of a steering angle of said steering angle detection means and a detection value of a steering angle of said steering angle detection means is characterized by comprising:
A comparison means to compare a steering direction of said steersman stage, and the steering direction by said actuator.
A control means which makes steering power of said actuator control when said steering direction differs from said steering direction.

[0009]The direction of displacement of a steering angle which is detected by said steering angle detection means according to the steering gear for vehicles concerning this invention, By judging that it is operating in the direction from which said steersman stage and said steering engine style differ when the direction of displacement of a steering angle detected by said steering angle detection means is compared and those for all directions differ, and controlling a size of steering power of said steering engine style, It can control that said steering engine style guides in the different direction from a steering direction of said steersman stage further, and a driver's sense of incongruity can be canceled.
[0010]
[Embodiment of the Invention]This invention is explained in full detail based on the Drawings in which the embodiment is shown below. Drawing 1 is a block diagram showing the composition of the important section of the steering gear for vehicles concerning this invention.
[0011]The steering engine style 1 for the steering gear for vehicles in this invention to make steering operation perform for the wheels 10 and 10 for the steering of the couple allotted to the

right and left of the body, Mechanically [ the steering engine style 1 ] The uncoupling steersman stage slack steering wheel 2, It has the steering control part 3 which uses a microprocessor, and has the composition of driving the steering motor 15 as an actuator which the steering control part 3 arranged on the steering engine style 1 according to steering of the steering wheel 2.

[0012]The both ends of the steering shaft 11 which the steering engine style 1 is formed in the longitudinal direction of the body, and are moved to shaft orientations, the steering knuckle arms 12 and 12 which support the wheels 10 and 10 on either side -- each -- it connecting with another tie rods 13 and 13, and by movement in the right-and-left both directions of the steering shaft 11. Push, lengthen and carry out the steering knuckle arms 12 and 12 via the tie rods 13 and 13, make right and left steer the wheels 10 and 10, and this steering, It is carried out by changing into the axial motion of the steering shaft 11 rotation of the steering motor 15 which consists of an electric motor formed in the halfway part of the steering shaft 11 according to the motion conversion mechanism which combines a gear and a ball screw.

[0013]One tie rod 13 and the connecting part of the steering shaft 11, and the steering shaft housing 14 that supports the steering shaft 11 enabling free movement to shaft orientations are straddled, The position sensing device 16 of the tie rod 13 which consists of a straight-line sliding type potentiometer is constructed, and the axial position of the tie rod 13 to the steering shaft housing 14 is detected. The detection result is given to the steering control part 3, and is used as a value replaced with the steering angle of the steering engine style 1.

[0014]The steering wheel 2 projects the steering shaft 20 to the down side, and is formed in it, and, as for the steering shaft 20, the body is suitably supported by the part via the tubed steering shaft housing 21, enabling free rotation. The steering shaft 20 is energized with the centering spring which was formed in the inside of the steering shaft housing 21 and which is not illustrated, and returns to a center valve position at the time of the stop of rotation steering of the steering wheel 2. This return is required in order to return the steering wheel 2 with the return to the advance direction of the wheels 10 and 10 produced in the steering engine style 1 side.

[0015]The motion conversion mechanism which combines a worm gearing and a pinion gear is provided in the halfway part of the steering shaft 20, and the reaction force motor 24 which becomes this from an electric motor is connected via the electromagnetic clutch which is not illustrated with the output shaft. The reaction force motor 24 is making the operation which applies to the steering wheel 2 the power (reaction force) of the steering direction and opposite direction which serve as size according to the height of the vehicle speed according to control lead from the steering control part 3. Therefore, it is necessary to add the steering torque which resists the reaction force which the reaction force motor 24 generates to rotation steering of the steering wheel 2, and this steering torque is detected by the torque sensor 22 which adjoined the motion conversion mechanism of the reaction force motor 24, and was formed on the steering shaft 20.

[0016]The steering angle of the steering wheel 2 is detected by the steering angle sensor 23 which uses the potentiometer attached to the steering shaft 20, and the detection result is given to the steering control part 3.

[0017]Like the above, the state of the guide actually produced in the steering engine style 1 side is

given to the steering control part 3 as an input from the position sensing device 16, and the state of steering of the steering wheel 2 is given to it as an input from the torque sensor 22 and the steering angle sensor 23. To these, in addition, the speed sensor 4 which detects the travel speed of vehicles and the yaw rate sensor 5 which happen when vehicles circle and which detects the angular velocity of the circumference of a vertical axis, i.e., a yaw rate, to the body, The lateral acceleration sensor 6 which detects lateral acceleration to the body, and the acceleration sensor 7 before and after detecting the acceleration of a cross direction to the body are formed in the proper part of the body, respectively, and those outputs are given to the steering control part 3.

[0018]The vehicle speed which the steering control part 3 computes a target steering angle according to the steering angle given from the steering angle sensor 23, and is given from the speed sensor 4, The yaw rate given from the yaw rate sensor 5, and the lateral acceleration given from the lateral acceleration sensor 6, Said target steering angle is amended according to acceleration before and after giving from the order acceleration sensor 7, and the steering motor 15 is driven so that the actual steering angle given from the position sensing device 16 may be coincided with the amended target steering angle.

[0019]According to the height of the vehicle speed which is given as an input from the speed sensor 4 as for the steering control part 3, By driving the reaction force motor 24 according to the target reaction force which determined that the target reaction force which should be given to the steering wheel 2 will consider it as size, and determined it, Steering with the feeling as the common steering gear (connected type steering gear) connected mechanically with same steering wheel 2 and steering engine style 1 can be performed now.

[0020]Drawing 2 is a flow chart which shows the control content of the steering control part 3 accompanying the drive of the steering motor 15. First, when the state of the key switch for engine start is checked (Step 1), it is ended when off, and it is one, incorporating the steering angle detected by the steering angle sensor 23 -- this steering angle -- the memory 3a -- storing (Step 2) -- a target steering angle is calculated based on the detection value of this steering angle (Step 3).

[0021]subsequently -- incorporating the actual steering angle detected by the position sensing device 16 -- this actual steering angle -- the memory 3a -- storing (Step 4) -- deviation $e_n$ of a actual steering angle and the target steering angle calculated at Step 3 is calculated (Step 5).

[0022]And the deviation of the steering angle incorporated at Step 2 and the steering angle of the past stored in the memory 3a is calculated (Step 6), and it is checked whether this deviation exceeds a predetermined value (Step 7). It judges that it is "under steering" when the deviation of a steering angle exceeds a predetermined value, and the deviation of the actual steering angle incorporated at Step 4 and the actual steering angle of the past stored in the memory 3a is calculated (Step 8).

[0023]Based on the deviation of the steering angle calculated at Step 6, and the deviation of the actual steering angle calculated at Step 8, the steering direction of the steering wheel 2, When you check whether the steering direction of the steering engine style 1 is in agreement (Step 9) and directions differ, let proportional gain Kp in the formula (1) for calculating output torque T of the

steering motor 15 be zero (Kp=0) (Step 10).

[0024]When the deviation of a steering angle is below a predetermined value after Step 10 or at Step 7, when a direction is the same, output torque T of the steering motor 15 is calculated based on a formula (1) at Step 9 (Step 11). Kd shows the gain of a derivative element and $E_n$ shows the time differentiation value of $e_n$.

[0025]$T=Kp\text{-}e_n+Kd\text{-}E_n$ -- (1)

[0026]And the steering motor 15 is driven according to calculated output torque T (Step 12), and the operation from Step 1 is repeated.

[0027]When the steering direction by the side of the steering engine style 1 is operating in the different direction from the steering direction of the steering wheel 2 like the above, By reducing the output to the steering motor 15 which operates the steering engine style 1, i.e., the motor current according to output torque T, the rotary place of the steering wheel 2 does not differ from the steering position by the side of the steering engine style 1 corresponding to it greatly, and a steering feeling improves by leaps and bounds.

[0028]When a driver returns the steering wheel 2 in the neutral direction after rotation steering of the steering wheel 2 in the steering gear for vehicles of composition and its hold of the steering wheel 2 is released like the above, Although the problem that the steering wheel 2 is rapidly returned to a center valve position by the reaction force motor 24 can be considered, In such a case, when it replaces with the steerage-reaction-force control according to the vehicle speed and the wheels 10 and 10 change to the steerage-reaction-force control according to the road surface reaction force received from a road surface, A return in the center valve position of the natural steering wheel 2 which followed the return in the center valve position (rectilinear-propagation traveling position) of the wheel by a self-aligning torque is realizable.

[0029]In order to realize steerage-reaction-force control according to road surface reaction force, as shown in drawing 3, The axial force sensors 17 and 17 which use a strain gage for the halfway part of the tie rods 13 and 13 of both sides are stuck, The axial tension (tensile force or compressive force which acts on shaft orientations) of the tie rods 13 and 13 which change with the reaction force of a road surface is detected as road surface reaction force, and the detection result is given to the steering control part 3. When the wheel 10 of one side has run aground to the curbstone, or when having fitted into the wheel 10 fang furrow of one side, in order to detect the state where reaction force with the road surface generated for the wheels 10 and 10 on either side differs, respectively, the tie rods 13 and 13 of both sides are equipped with the axial force sensors 17 and 17.

[0030]The steering control part 3 drives the reaction force motor 24 according to the vehicle speed, when it is not in a state without holding, When it is in a state without holding, it is made to have driven the reaction force motor 24 according to the target reaction force which determined that the target reaction force which should be given to the steering wheel 2 according to the size of the axial tension given as an input from the axial force sensors 13 and 13 will consider it as size, and determined it.

[0031]Detection of a state without holding is judged by the steering torque given as an input from the torque sensor 22, and when steering torque is below a predetermined value, it is made to have judged that it is in a state without holding.

[0032]Drawing 4 is a flow chart which shows the control content of the steering control part 3 accompanying steerage-reaction-force control. First, when checking whether the steering torque detected by the torque sensor 22 is incorporated (Step 1), and the incorporated steering torque exceeds a predetermined value (Step 2) and exceeding a predetermined value, it judges that it is not in "a state without holding", and the usual steerage-reaction-force control like the above-mentioned is performed (Step 3). It judges that it is in "a state without holding" in below a predetermined value, and the axial tension of the tie rods 13 and 13 detected by the axial force sensors 17 and 17 is incorporated (Step 4), and the reaction force motor 24 is driven according to the incorporated axial tension (Step 5).

[0033]

[Effect of the Invention]In the steering gear for vehicles applied to this invention as explained in full detail above, The direction of displacement of the steering angle detected by said steering angle detection means is compared with the direction of displacement of the steering angle detected by said steering angle detection means, By judging that it is operating in the direction from which said steersman stage and said steering engine style differ when those for all directions differ, and making the size of the steering power of said steering engine style control, It controls that said steering engine style guides in the different direction from the steering direction of said steersman stage further, and this invention does the outstanding effect so -- a driver's sense of incongruity is cancelable.

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[Translation done.]